ROCKY MOUNTAIN RHIZOPODS.

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DURING a stay which I made this year in the mountains of the state of Colorado I gave some of my time to the study of the fresh-water Rhizopods, comparing them with those I had observed in various regions of Europe. I should like to give here the results of my comparisons.

All the organisms which are treated of in this paper have been found in the neighborhood of Caribou, a small mining town north of Boulder, and about 10,000 feet above the level of the sea. At this altitude Rhizopods are still numerous, as Leidy has shown in his remarkable work on the fresh-water Rhizopods of North America. He found them abundant in the Uinta Mountains, Wyoming, at 10,000 feet,—the highest altitude, I believe, at which these organisms have as yet been found. However, as will be seen later, my gatherings at 12,000 feet have been very productive, which is after all not to be wondered at, knowing the very great capacity of these organisms for resisting either cold or heat, or any other disturbing element. In fact, they can be expected to be found everywhere, provided there are mosses and humidity, and if I have not found them higher (except one species, *Difflugia constricta*, at 12,500 feet), it is only because the ground was unfavorable to the presence of quiet water, and that my investigations at these higher altitudes have been very few.

I have no intention to speak about the organization and physiology of these organisms. Leidy, in his beautiful work, has treated the subject at length. I would simply like to give a list of the species I have found in the Rocky Mountains, adding some remarks about a few of them, and finishing with some observations on the structure of the shell in these animals. This structure is not very well known in most of the species; and as I have in these latter years accumulated a good many observations in this connection, I venture to detail them here, in the hope that they will prove of some interest.

I give now the list of the species I collected in various bogs or swampy grounds in the neighborhood of Caribou, and at a height varying from 10,000 to 10,500 feet. The animals were mostly found among mosses and sphagnum, whose presence at that altitude is itself remarkable.

Amœba limax Dujardin, *Amœba verrucosa* Ehrenberg-Leidy, *Difflugia pyriformis* Perty, *Difflugia arcula* Leidy, *Difflugia lucida* Penard, *Difflugia fallax* Penard, *Difflugia bacillifera* Penard, *Difflugia constricta* Ehrenberg, *Centropyxis aculeata* Stein, *Arcella vulgaris* Ehrenberg, *Arcella vulgaris* var. *angulosa* Leidy, *Arcella discoides* Ehrenberg, *Arcella microstoma* Penard, *Quadrula symmetrica* Schulze, *Lecquereusia jurassica* Schlumberger, *Nebela collaris* Leidy, *Nebela longicollis* Penard, *Nebela tubulosa* Penard, *Nebela dentistoma* Penard, *Heleopera rosea* Penard, *Assulina minor* Penard, *Pseudochlamys patella* Claparède and Lachmann, *Cryptodifflugia oviformis* Penard, *Cyphoderia margaritacea* Schlumberger, *Euglypha alveolata* Dujardin, *Euglypha ciliata* Leidy, *Euglypha cristata* Leidy, *Euglypha compressa* Carter, *Euglypha lævis* Perty, *Sphenoderia dentata* Penard, *Trinema lineare* Penard, *Trinema enchelys* Leidy, *Trinema enchelys* var. *galeatum* Penard, *Trinema complanatum* Penard, *Corythion dubium* Taranck, *Corythion pulchellum* Penard.

All these species, which did not differ in any particular from those which have been described from Europe, India, Australia, or from various parts of the United States, were generally found represented by very numerous individuals. Yet sometimes a very few were present in a given locality, or again some given species, entirely absent from one place, was abundant in another and very near one.

But there are a few of these species on which I should like to write at some length :

Difflugia pyriformis Perty.—This species is extremely variable ; or rather, if I may be allowed to express a personal opinion, should be and will be one day decomposed into a large number of distinct specific forms, some of which again will show an undeniable tendency towards a great variability. In fact, my observations, which have been protracted for several years and made on

more than 200 gatherings in various localities of Europe, have brought me to the conclusion that many autonomous species of Rhizopods have acquired in their evolution and in independent ways the form *pyriformis.* Indeed, this simple and efficient shell is exactly the kind one would expect to be formed by an organism in its first stages of evolution from the amœba condition to that of a testacean Rhizopod.[1]

However it may be, if the following conditions are considered sufficient to determine a species:

1. The general characters of the shell (form, size, structure, composition) are sharp and constant in a form A, though not far distant from those of other forms B, C, etc.

2. In the state of copulation (conjugation) A is always seen together with A, and never with B or C, etc.

3. In certain localities A is to be found alone, whilst B or C are not present.

4. Intermediate forms between A and B, or C, etc., do not exist, or at least are very exceptional cases.

If, I repeat, these characters, accumulating in one and the same form, are considered sufficient to make of that form a distinct species, then it would be easy to separate the *Difflugia pyriformis* Perty in a dozen at least of such autonomous species.

Now I have observed at Caribou several different forms of *Diff. pyriformis*, and especially one that I found very abundant in several localities deserves a particular mention. With the typical form of the species, and built of angular grains of quartz, sometimes with admixture of a few diatoms, its shell was remarkable by virtue of a large amount of brownish matter (oxide of iron), dissolved in a chitinoid magma, which generally formed a brownish substratum or inside lining to the shell. Now we must observe that in those species of Difflugia whose shells are normally and essentially formed of sand particles, the proportion of

[1] At the same time, and whilst this explanation may be good in a general way, I am inclined to think that some of the forms or species so formed would still be in an unfixed state, and might be compared to such forms of vegetable life as Rosa, Rubus, Hieracium, which with their many varieties constitute the bliss of some, but the despair of most, collecting botanists.

chitinoid matter is normally very slight, and this particular Difflugia is an interesting exception.

Quadrula symmetrica Schulze.—I have found this beautiful species abundantly in most of my gatherings, but mostly represented by very small-sized individuals (length 0.040–0.060 mm.). On the contrary, in one single locality the species was to be found under what might be called a giant form (length 0.100–0.150 mm.), which presented this other peculiarity, that the square plates composing the shell, instead of being disposed, as in the typical form, in a high degree of symmetry, showed great disorder in their arrangement, and very often overlapped each other. The sides of the shell, instead of looking like a tolerably continuous curve, appeared like a series of broken short lines. These two varieties, if they must be considered as such (in my opinion, they are more than varieties), were very sharply distinct, and I have not seen any transitional forms.

Nebela collaris Leidy.—This species also was represented at Caribou by two very distinct forms: first the typical one (forma *genuina* Taranck), not very abundant as a rule, and totally absent in some places; then another form, or dwarf variety, extremely abundant, and often to be found quite alone in some localities. This latter form agrees perfectly with a variety which Leidy has figured in his great treatise (Pl. XXII., Figs. 11, 12, 16).

Nebela longicollis Penard.—Rather abundant in nearly all my gatherings. The species is very different from the preceding; yet the form I found at Caribou could hardly be referred to the *Nebela longicollis* such as I described it in 1890[2] (which appears to be the same as *Neb. barbata*,—Leidy, Pl. XXIV., Figs. 14–17). It agrees, on the contrary, very well with two shells figured by Leidy (Pl. XXIV., Figs. 18, 19) as "intermediate in character to *Neb. barbata* and *Neb. collaris*," and at the same time shows relations to the form that I called *lageniformis*. I mention here the Caribou form under the name *longicollis*, being of opinion that *Neb. barbata* and the two Figs. 18 and 19 of Leidy refer to one

[2] Etudes sur les Rhizopodes d'eau douce. Mémoires de la Société de Physique et d'Histoire naturelle de Genéve, 1890. All the species mentioned in this paper, and which bear my name, have been described in the same work.

and the same species; and at the same time I avoid the use of the name *barbata* because it appears to me to be the result of a confusion of the author, who took foreign and parasitic elements for normal covering setæ.

As already stated, those species found at 10,000 feet did not as rule show any difference from those described from the plains or in other continents, and showed the same relative abundance of individuals. Yet it will not be without interest to refer here to the utter absence of several forms of Rhizopods which one would have expected to find, and among which I shall only cite *Hyalosphenia papilio* Leidy, *Nebela flabellulum* Leidy, and *Assulina semilunum* Leidy. *Hyalosphenia papilio* is a very constant inhabitant of sphagnum-mosses; I do not think I ever found in Europe a single bunch of sphagnum that was not replete with it. *Nebela flabellulum*, according to my experience, mostly affects the mosses in the woods, yet it is very frequently found in sphagnum. As for *Assulina semilunum*, its place was taken at Caribou by the species I have called *Assulina minor*. This latter form might be considered a dwarf variety of the former, and in fact must have been so regarded by Leidy, who has figured two shells belonging apparently to it (Pl. XXXVII., Figs. 15 and 26). But besides the considerable and absolutely constant difference in size, there are others characters which decided me to make of it a distinct species, and the fact that at Caribou this form was absolutely the only one to be met with would constitute, if necessary, further proof of the correctness of my decision.

I come now to the list of the species that I found in the mosses of a swampy pasture-ground, under the summit of the hill called Bald Mountain, and about 12,000 feet above the level of the sea. Sphagnum does not grow at so high an altitude, and consequently was not represented among these mosses: *Amoeba* ———, sp. nov.? *Difflugia pyriformis* Perty (small variety), *Difflugia constricta* Ehrenberg, *Difflugia rubescens*, sp. nov., *Nebela collaris* Leidy (and small variety), *Nebela longicollis* Penard, *Nebela dentistoma* Penard, *Arcella microstoma* Penard, *Pseudochlamys patella* Clap. and Lachmann, *Heleopera rosea* Penard.

All these species were to be found in very numerous individuals; in fact, as numerous as 2,000 feet lower down. Yet to that list ought to be added: *Euglypha ciliata* Leidy, one specimen; *Trinema lineare* Penard, one specimen; *Assulina minor* Penard, a very few specimens.

An interesting fact seems to me to be that, with the exception of the very few individuals belonging to the three latter species, which I found after much exertion among hundreds and hundreds of other rhizopods, all the species mentioned in the list belong to the section of the Rhizopoda known as "Lobosa,"—*i. e.*, with broad and blunt pseudopodia. The section "Filosa,"[3] including those Rhizopods with filiform pseudopodia (Euglypha, Trinema, Sphenoderia, etc.), so rich in species, and yet more so in individuals, which generally swarm everywhere and outnumber the Lobosa, have been found to be practically absent at a height of 12,000 feet. My observations, which concern only a single locality, are not sufficient to enable me to draw from that absence any certain conclusions; yet, at any rate, they seem to show a remarkable difference in the vital resistance between those two great divisions of fresh-water Rhizopods.

Among the species mentioned in the list I find two of them which must be dealt with at some length:

Difflugia rubescens, sp. nov.—Very likely this form has been seen by Leidy; indeed, he figures two shells which I think must be referred to this organism (Pl. x., Figs. 24, 25) as belonging to *Difflugia pyriformis*, and with the statement "with brown endosarc." But we have most certainly here a distinct species, which I shall call *Difflugia rubescens*. It was very abundant. I have examined several hundreds of specimens, which have all proved to be remarkably constant in form, size, and structure. The shell, pyriform, not compressed, not quite twice as long as broad (length, 0.030–0.035 mm.), consists first of a pellicle of clear chitinoid material, always covered with diatoms. These

[3] Leidy separates the fresh-water Rhizopods into two great divisions, Lobosa and Filosa. This corresponds, in fact, to two very natural groups; yet I must mention that a few Rhizopods (Cyphoderia, Cryptodifflugia, some Pseudodifflugia, and some Amœbæ) show intermediate characters in their pseudopodia, which are capable of passing from one form to another in a comparatively very short time.

diatoms, though belonging always to small species, occupy, each of them, a relatively large place on the shell, and give rise to a very general deformation of its otherwise regular contours (as indicated by the chitinoid substratum). Sometimes among the diatoms are to be found one or two quartzose grains. In the main the structure of the shell is the same as that of *Diff. bacillifera* Penard, but the form and size are different. Besides,—and this is the most important character of the species,—the plasma has normally and constantly a beautiful brick-red color, resembling that, for instance, of *Vampirella lateritia* Fresenius. It would have been interesting to investigate if in this species the pseudopodia present in their outstretched state the general colorization of the plasma. Unhappily all the animals were at the time of examination retracted in their shell and in course of encystment; and in spite of observations extending over a space of more than two weeks, I have never noticed an extended pseudopod. Yet from analogy with what I have seen in *Vampirella lateritia*, and in an Heliozoon (*Artodiscus saltus* Penard), I am inclined to think that the pseudopodia, or at least their terminal parts, must be deprived of colored matter. It is perhaps not useless to add that the red color had certainly nothing to do with foreign matter, algæ or digested products. The nucleus, generally invisible, was nevertheless sometimes quite distinct; acetic acid brought it easily to view. It did not differ in any respect from the nuclei of other Rhizopods. No contractile vesicle was present, owing very likely to the encysted state of the plasma.

Amœba ———, sp. nov.?—This amœba was rather abundant, and very constant in its form and organization; yet I have not followed it long enough to describe it as a new species. It was very small (diam., 0.010 mm., without the pseudopodia), and consisted of a spherical, clear body, normally covered by a layer of greenish, but not shining, transparent globules, finely punctulate, about 0.002 mm. in size, and forming a continuous envelope. These globules were apparently of protoplasmic nature, and a product of secretion of the animal itself. They were mostly associated with a small number of shining, irregular particles of what appeared to be amorphous siliceous matter. Sometimes, how-

ever, these particles were present in such abundance that they built up the greater part of the envelope and took the place of the protoplasmic globules, which were then only few in number. The pseudopodia were mostly much elongated,—four or five times as long as the diameter of the animal, or more,—very slender, and gradually tapering from the base to the summit, which was filiform. They were straight, rigid, few in number (about half a dozen), and were capable of radiating in every direction, while the animal walked on their points. At other times the animal would crawl along the grounds, slightly compressed at its point of contact, and then the pseudopodia would be shorter, less rigid, and flattened.

The nucleus and the contractile vacuole could not be seen, being hidden behind the envelope of globules. In short, this species recalled very much the *Amœba radiosa*, from which it was distinguished by its constant protective envelope, as well as by its very much smaller size.

Having in the preceding pages given a description of the Rhizopods I found in the Rocky Mountains, I should like to present a few general remarks on the structure of the shell in these animals.

These organisms have sometimes been divided into "Nuda" and "Testacea." There exist some transitional species, whose plasma is simply hardened on most of its surface, or covered with protective granules, or is even differentiated into a genuine double-contoured, supple, and membranous covering. But in what follows I shall only treat of the true "Testacea," with a solid and rigid shell. The Testacea constitute by far the greater part of fresh-water Rhizopods.

The nature of the shell in these beings is as yet little known. Generally speaking, and after consulting most of the works that have been written on these animals, one arrives at the following conclusion: The shell of the fresh-water Rhizopods is chitinoid, often with an admixture, in various proportions, of siliceous elements (sand grains, diatoms, scales).

My observations, which have been made on nearly all the known species, allow me to modify the preceding opinion, and to

present the following statement, which holds good for all hard-shelled Rhizopods:

The shell of fresh-water Rhizopods is composed of two elements: (*a*) Silica, always in the form of detached pieces, and forming most of the mass of the shell; (*b*) chitinoid, or chitino-siliceous matter, serving as a substratum or soldering magma.

(*a*) SILICA.

Silica is first found represented by fine particles of sand. In this state it generally constitutes nearly the whole of the shell in the genus Difflugia, especially in the species of this genus which frequent the bottoms of rivers or clear-water ponds. In these latter species the amount of chitinoid matter is so small as to be scarcely discernible, and the shells, when compressed, show hardly any elasticity, their various elements or sand particles being easily disaggregated.

Besides being found in Difflugias *sensu stricto* (denoting thereby those species of the genus whose shells are normally built of quartz grains), silica in the state of sand particles can be found in many Rhizopods (Difflugia in part, Centropyxis, Heleopera, etc.), but in these cases generally forms a part only, and not an important one, in the constitution of the shell.

I must mention here a very curious fact, to which I called attention in 1880, and which the observations I have since made at Geneva on a new interesting species have shown me to be of more frequent occurrence than I at that time thought; namely, that in certain species (*Diff. lucida, Diff. fallax*) the shell, very much like that of one built up of true sand particles, is in reality covered on its entire surface with amorphous siliceous elements, transparent, colorless, often rather flattened, less angular than real stones, a product of the animal itself, and constituting in these species a remarkable case of mimicry.

Very often, and in numerous species, silica is to be found as amorphous plates or scales, seldom alone (*Helcopera rosea*), more often mixed up with sand grains or other elements (diatoms).

Diatoms are very frequent in a great number of species (Difflugia i.p., Pseudodifflugia, Centropyxis, Lecquereusia, Nebela, etc.). It

is very seldom that they constitute normally the total covering of the shell (*Diff. bacillifera, Diff. rubescens*); yet, even in species where as a rule these algæ only make up a part of the envelope, one may always expect to find isolated specimens where they constitute the total covering.

All the siliceous elements which I have until now mentioned are irregular, either in their form or in their relative sizes on the shell; but there exist a whole series of genera where these elements are conspicuous by their geometrically regular form. However, before speaking of these I shall mention some forms which occupy a somewhat intermediate position. They belong to the family of Nebelidæ. In this family the siliceous elements are represented by regular circular or oval discs, contiguous with each other and covering the whole shell. Sometimes all these discs are very nearly of the same size all over the shell, at other times large ones are mixed up with very much smaller ones. These discs are generally very conspicuous, but in the genus Hyalosphenia and in some Nebela they cannot be seen, and the shell looks as if it were composed of a continuous chitinoid membrane. Yet in these species it is most probable that the discs really exist, but are very thin, and hidden in the abundant chitino-siliceous matter of the envelope.

We now come to those genera in which the siliceous scales have regular forms and are symmetrically disposed. The genus Quadrula is remarkable for its square, colorless scales, touching each other with their borders and arranged in regular series. In the numerous species of Euglypha the plates are oval, sometimes circular, seldom cordiform, but always perfect in their shape, disposed in diagonal series over the whole shell, and slightly overlapping each other. The circular or oval plates of Sphenoderia, Trinema, Placocysta, are also perfect; but in some species, owing to the form of the shell, they may vary very much in size in different regions of the shell. In the *Assulina semilunum* the plates are elongated, very thick, and often incline to a slight asymmetry. In *Corythium dubium* they are still all alike, but have more the shape of an elongated rectangle.

(*b*) CEMENTING MATTER.

In all testaceous Rhizopods the siliceous elements are cemented by or sometimes lie on a substance which may be called chitinoid, or rather chitino-siliceous. This matter, often quite transparent and colorless, but sometimes colored,—yellow, dark purple in some Arcellas, pink in *Heleopera rosea*, chocolate-brown in Assulina,—is more or less abundant according to the species. Nearly absent in the Difflugias *sensu stricto*, and in very small quantity in Euglypha, Quadrula, etc., it varies considerably in thickness in the series of species, generally making an internal varnish to the inner side of the shells, thence penetrating between the plates or other siliceous elements, sometimes overlapping them at the outside, and forming as it were relief veins or exudation droplets. But it never makes up the entire mass of the shell, and it is only very seldom (Hyalosphenia) that it constitutes the principal mass of the same.

I have called this matter chitino-siliceous, because, in fact, I am inclined to consider it as consisting of a mixture of chitinoid matter and of an infinity of extremely small siliceous particles imbedded in the magma. This is but a supposition, yet it may perhaps give an explanation of the following facts: This matter, in the pure state and without admixture of foreign elements, as it occurs for instance in the genus Centropyxis, resists the action of red heat (blow-pipe) or of cold, concentrated sulphuric acid, but disappears completely in boiling sulphuric acid. This I would explain by saying that in both cases the chitinoid matter is dissolved, but that whilst by mere heating the siliceous particles becomes soldered to each other during the process, the convection currents in the boiling sulphuric acid disperse them. The following experiment explaining the relations between the plates of the shell on the one hand and the connecting matter on the other, may at any rate give some probability to the explanation just given concerning the chitinoid matrix: I have found that the shells of all the testaceous Rhizopods resist both red heat (blow-pipe) and cold, concentrated sulphuric acid, but that this acid when boiling, after separating the plates from each other,

disperses them so widely in every direction that it is generally impossible to find them again. Yet, if one takes the precaution to isolate a shell (say Euglypha) in a very small drop of acid, one finds after the action of the boiling acid all the plates again; but they are dissociated from each other, and in a little heap. In this case the chitinoid matter is gone, and has left only the pure siliceous plates.

At the same time, it must be added that in some species the cementing matter seems to be purely chitinoid in some regions of the shell; for instance, about the mouth in *Sphenoderia dentata*, *Corythium pulchellum*, and others.

There are two genera of which I have not yet spoken, and concerning which I should like to say a few words,—namely, Cyphoderia and Arcella.

The shell of Cyphoderia, with its elegant covering of small, regular, hexagonal alveoli, is very currently considered to be made up, first, of an internal, brownish, chitinous pellicle, and then of an external envelope, itself consisting of hexagonal, chitinous prisms. The experiments I made at Geneva on this species have shown me that it is not so. In reality, the internal chitinoid pellicle is covered over its whole surface with small discs, or rather cylinders, consisting of pure silica. These I was able to isolate and examine on all their faces. They are circular in section, about one-third larger in diameter than in height, flat, or very little excavated on their upper and lower faces, and have altogether the form of fish vertebræ. Their diameter is in the bigger shells (var. *major*) about 0.002 mm.; their size is uniform over the whole shell. They are disposed with a wonderful regularity, touching each other by the borders, and cemented together by the chitinoid matter which penetrates into the interstices and often flows out to the outside. The appearance of hexagonal alveoli is a result of the juxtaposition of all these small cylinders and of the interposition of the cementing matter.

As for the shell in Arcella, I feel confident that it is analogous to that of Cyphoderia; but the siliceous elements are very much smaller, and the experiments I have made have not been decisive. Yet I have seen on broken shells that the lines of fracture were

covered with denticulations of uniform size, as they are seen on broken shells of Cyphoderia, each tooth representing a siliceous disc. I ascertained also that these shells resist very well a red heat, but after the action of boiling sulphuric acid I was not able to find the discs with certainty.

As for the origin of all these regular siliceous elements in Rhizopods, it is well known now that it must be looked for in the plasma itself. The animal has the power of secreting these siliceous plates in the very inside of its body, and in many species (Quadrula, Euglypha, etc., etc.) these plates can be seen very frequently in the plasma, either lying there without any order, or, on the contrary, disposed in regular layers. I will mention here that the species Cyphoderia has always been described as very generally containing, especially at the posterior part of its plasma, a considerable number of shining, very refractive grains, that were supposed to be starch or excretion granules. Now I have been able to isolate these granules, and to satisfy myself that they resist both red heat and boiling sulphuric acid,—a fact which proves them to be siliceous, and to represent nothing but plates in course of formation, destined ultimately to build up another shell. It is well known, indeed, that these reserve plates (Reserveplättchen), as they have been called, will not be of any use to the animal that formed them, but serve to make up a shell for a new animal. An individual A, for instance, full of reserve plates, expels these plates through its mouth, together with some of its own plasma. The whole plasma becomes highly vacuolated, and thus augments in volume; the expelled portion, still attached to the mouth of the parent, takes the form of the species, and the plates are disposed as an outer covering, and in the most beautiful order.

These reserve plates are certainly a product of the animal itself, which has thus the power of secreting silica. Besides, from very numerous observations on shells (especially Nebela) on which all transitions are to be seen from perfect diatom cases to very simple rods that have lost all precise form, it appears certain to me that, as Wallace suggested, the plasma of Rhizopods has the power of deforming and partly dissolving the shells of diatoms.

Sometimes, however, some of the investing elements can be seen which must have been directiy deposited on the shell from the outside,—inorganic particles and diatoms which are much too large ever to have gone through the mouth of an individual belonging to the species.[4] At other times, again, the whole shell seems to have been formed by external apposition, as in many specimens of *Pseudodifflugia hemisphærica* which I have examined, in which nearly the whole of the shell was made of diatoms, still containing their plasma and their yellowish or brown chromatophores.

Before concluding, I would emphasize the constant dislike of Rhizopods for limestone. Not only are limestone countries always poor in Rhizopods, as Leidy showed in 1879, but even species that easily endure the presence of lime will never use any particle of it for the building of their shells. In the spring of this year I examined numerous species of Difflugia which inhabited the muddy bottom of Geneva. This mud, under the microscope, is seen to be composed of a mixture in nearly equal proportions of very fine particles of quartz and transparent limestone. A little chip of limestone, two- or three-thousandths of a millimeter in diameter, often very closely resembles another such chip of quartz. Without a careful examination a professional observer might easily be deceived; but a Difflugia is not, and will always choose quartz particles for the building materials of its shell.[5]

[4] Indeed, in some forms (*Difflugia bacillifera*, *Diff. rubescens*) this seems to be the only way in which the shell can be built.

[5] Besides these Rhizopods, I have found, of course, mixed with them, many other organisms,—Infusoria, Flagellata, Rotifers, Nematodes, etc. Of these I will cite only two Cilioflagellata, *Glenodinium cinctum* and *Peridinium tabulatum*, and three Heliozoa, *Actinophrys sol*, *Heterophrys* —— ? *Acanthocystis myriospina* Penard? (*Acant.* —— with simple spines, Leidy); fine specimens of this latter were abundant at 12,000 feet